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Head Loss Modelling with Advanced Hydroinformatic Tool in Sprinkler Irrigation Facilities, Study Case: Sprinkler Irrigation Facilities on 400 ha in Iohanesfeld, Romania

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Abstract

In in the last 10-15 years, droughts in Banat Plain have imposed finding new sources of water for irrigation application on drained land. This paper presents irrigation facilities on 400 hectares on a private area using modern sprinkler irrigation installations, with Bega River being the water source. The installations use modern mobile watering devices: centred pivots and hose - drum irrigation, longitudinally propelled. The water intake for the irrigation application is taken from Bega River and transported over a distance of 12.9 km through the existing network of drainage channels, accumulated in a storage pool from which it is pumped in the underground through a network of pipes and distributed to the crops by mobile sprinkler irrigation equipment. Thereby this sprinkler irrigation facility is using the existing drainage network to transport water from the source to landscaped area. The numeric modelling was performed using MIKE11 by DHI software, HD module. The Hydrodynamic (HD) module is the nucleus of the MIKE 11 modelling system and forms the basis for most of the modules including Flood Forecasting, Advection-Dispersion, Water Quality and Non-cohesive sediment transport modules [1].

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Keywords: mobile irrigation installations, central pivot, sprinkler irrigation system, water resources, water quantity, head loss;

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1. Introduction

In Banat Plain, 50 years ago, groundwater level was high in many areas, Swamps were frequent in many areas. The excess of moisture lead to drainage facilities implementation. Accelerated drainage in the last 45 years, following the work of damming, regularization of rivers and construction of other drainage works, resulted in lowering the groundwater level so that in dry years it became absolutely necessary to apply irrigation, independent of climatic evolution. Increased global warming in the last decade imposes priority to the irrigation facilities and makes agriculture sustainable [6].

If, during approximately 65 years ago, the main concern in the field of land reclamation works was to develop them independently, it is imperative to treat it complex to keep in view the need for environmental protection, which is seriously affected by the action of human activities and even more in areas with high humidity. In this context it is necessary to identify limited surface water courses source in the Banat Plain (Mures, Bega, Timis) and a small amount of groundwater. The existence of a network of dense drainage channels that during spring would allow the accumulation of a quantity of water to be used for the application of the first watering for some areas related to them. In summer, when water is scarce, where technical condition allows the water slope flow direction to be changed, to be supplied with water for irrigation. So it will be fulfilling a dual role, drainage during autumn, winter and spring, and in summer ensuring the transportation of water for irrigation to surfaces to be irrigated [4].

In this context starting from the systematization (completion) rehabilitation of drainage channels in the area of 450 ha property owned by SC AGROTOT2000 SRL, the challenge was to find the source of water for irrigation on a surface of 400 ha. Propose of sprinkler irrigation facilities are to ensure the realization of stable production independent of climatic evolution during that year, while achieving higher production per unit area. Water source is a water intake rehabilitated on the river course of Bega River at kilometer 8. Water feed channels from the water intake to the irrigated area (CS10 channel, CP3 channel, Temesit Valley, CP10 channel) have a length of 12.9 km and are in public property managed by ANIF Timis - Lower Mures Territorial Branch [5].

2. Study Case

Sprinkler irrigation arrangement at SC AGROTOT 2000 SRL consist of a total of 800 ha composed of a body of 400 ha (step 1) on administrative land of Otelec commune in Iohanesfeld village and another body of 400 ha (step 2) on administrative land of Giulvaz commune in Ivanda village. Owner of the arrangement is the beneficiary of arable land in tabular and extra tabular of Ionel village, Otelec commune, Timis County, covering the total area to be irrigated in step 1.

The proposed site for this project is located extra-tabular in the western part of the village Ionel [Iohanisfeld] near road link towards Ivanda village, county road DJ693B. Water source is water intakes rehabilitated on the river course of Bega River at Km.8 [2] (Figures 1).

In step 1 workings will be carried to the water feed channel from Bega river at km 8, which is proposed to be rehabilitated, on the route of existing drainage canals in Teba - Timisat drainage system which are under the current exploitation of ANIF Timis - Lower Mures Territorial Branch, on the accumulation of water consisting in a basin of 3.1 ha with a possibility of accumulation of water volume of 120.000 cubic meters, respectively on the underground pipeline network of the body 1 consisting of an area of 400 ha in Ionel locality, on the pumping station and acquiring of mobile sprinkler irrigation equipment. The mobile irrigation equipment comprises two types of equipment (Figure 2):

- Central Pivot irrigation installations - 4 pieces;
- Irrigation installation system with hose and drum fitted with nozzles water spraying ramp - 2 pieces.

From the water source, Bega River at km. 8, the course of the water supply channel for irrigation is: Bega outlet channel, CS10 channel, CP3 channel, hydro node NH3, Temesit Valley, hydro node NH4, CP10 channel to the confluence with CS7 channel (where water is discharged into the accumulation basin). On the channels at spill section are expected to be realized plane weirs (and / or bulkheads) to ensure the transport of water from the source to the accumulation basin for irrigation located on owned land by the beneficiary. Existing culverts owned by the ANIF Timis - Lower Mures Territorial Branch on the route of the irrigation supply route will be unclogged and if necessary

repaired. Inflow channels on the route will be re-profiled under the bottom of the original profiles designed of Teba – Timisat drainage system operated by ANIF Timis - Lower Mures Territorial Branch.

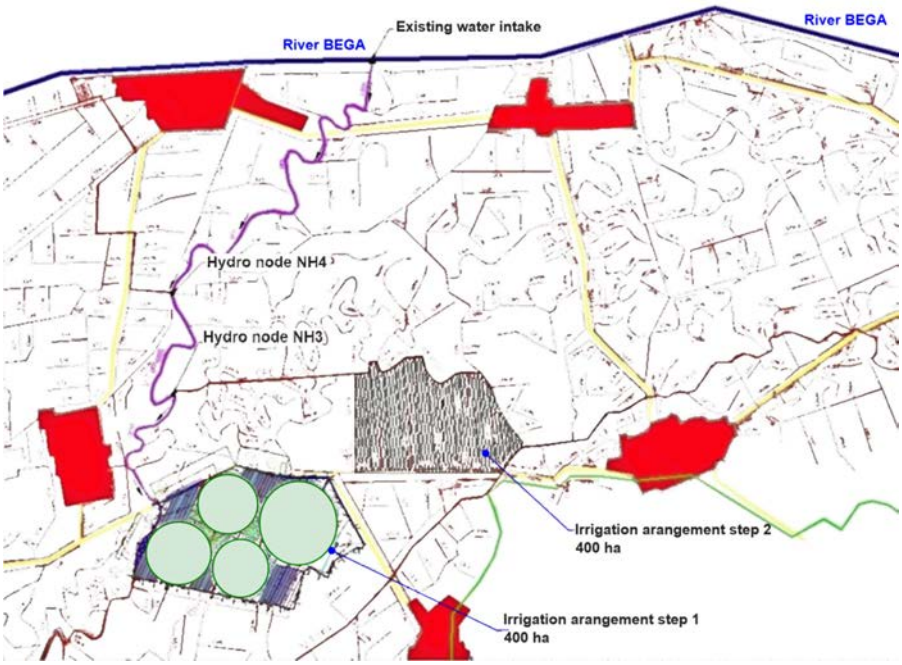

Fig. 1. Area plan.

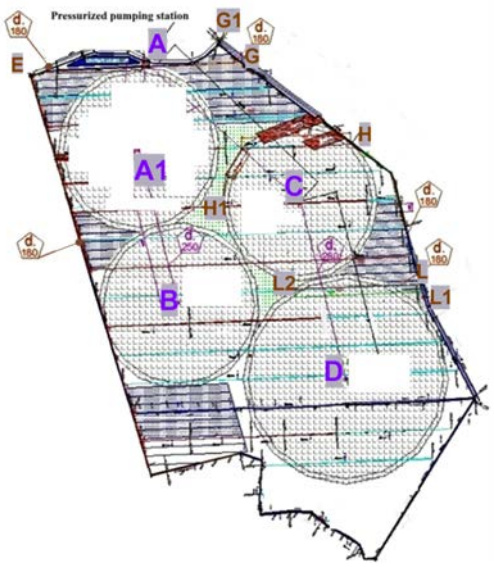

Fig. 2. Irrigation arrangement plan.

Water feed channels from the outlet to the irrigated area (CS10 channel, CP3 channel, Temesit Valley, CP10 channel) have a length of 12.9 km and are in public property managed by ANIF Timis - Lower Mures Territorial

Branch (Figure 1). It will use four central pivot installations and two sprinkler irrigation installations with hose and drum longitudinal propelled, which requested total flow is 1.150 $m^3.h^{-1}$.

- central pivot installations (4 pcs.) Urapivot length 450 m and terminal irrigator pump revival.
- sprinkler irrigation installations with hose and drum longitudinal propelled (2 pcs.) and dip galvanized coil structure with hydraulic pump group (approx. 80 mc / h, 4 / 5 bar) equipped with control panel and control functions, wing rain that wet a strip of 50 m [3]. The data required for modelling are: modelling area plan (Figure 3); longitudinal profile of channel; cross-sections along channel (Figure 4).

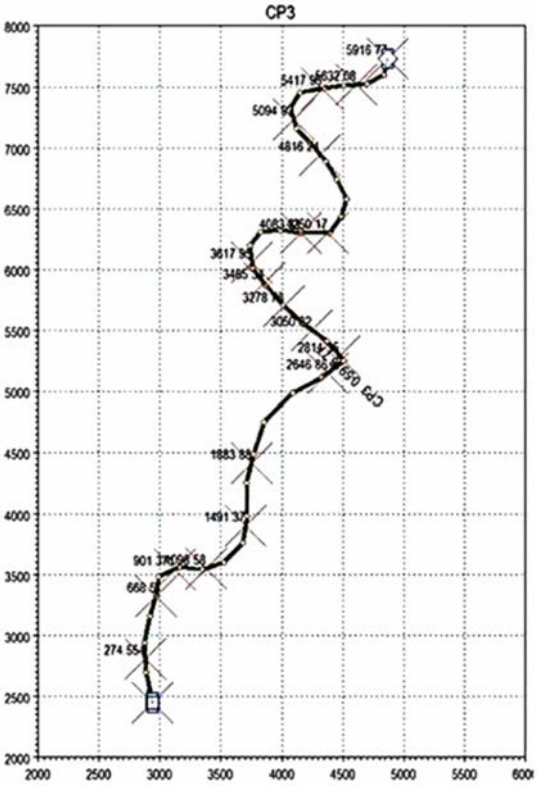

Fig. 3. Area plan with location of cross sections.

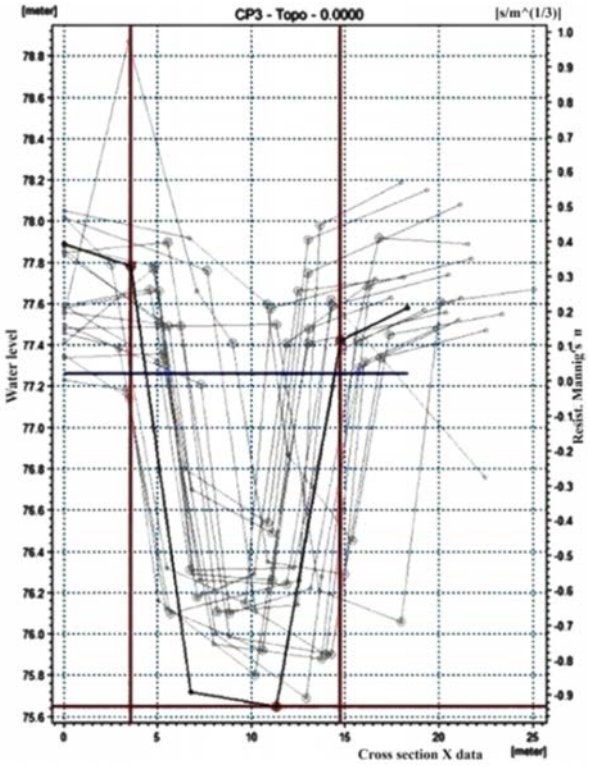

Fig. 4. Cross sections topographical data.

3. Results and Discussions

Numerical modelling was performed with the program MIKE11. According to data entry or formulated boundary conditions, namely the upstream inflow at chainage 5916.77 are time variant inflow and in the downstream at chainage 0 curve key for downstream section of the channel. After running the program MIKE11 was obtained through existing channel longitudinal profile, presenting water levels along the channel (Figure 5).

4. Conclusions

This study presents the application of a one-dimensional unsteady flow hydraulic model used for the simulation of flow in rivers: the MIKE 11 model from the Danish Hydraulic Institute (DHI). Advantages of MIKE 11 (1D model) are: possibility of accurate hydraulic description in rivers/channels which are one-dimensional flow with many complex hydrotechnical structures; short simulation time; easy to view analyses and extract results.

MIKE 11 is the preferred choice of professional river engineers when reliability, versatility, productivity and quality are the keywords. By implementing this irrigation arrangement using the existing network of drainage

channels, investment costs are lower and requires no additional earth excavating works which can lower agricultural land areas.

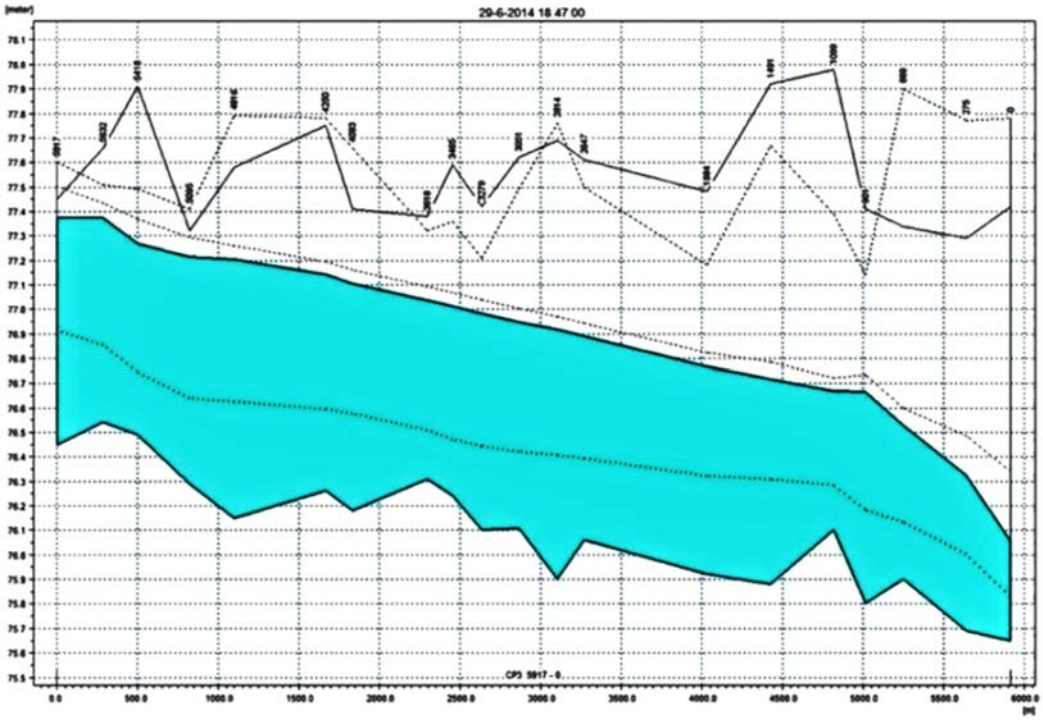

Fig. 5. Water level in each cross section.

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